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Syndrome of Acute Anxiety Among Marines After Recent Arrival at High Altitude

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ABSTRACT Management of mental health is critical for maintenance of readiness in austere military environments. Emerging evidence implicates hypoxia as an environmental trigger of anxiety spectrum symptomatology. One thousand thirty-six unacclimatized infantry Marines ascended from sea level to the Marine Corps Mountain Warfare Training Center (2,061–3,383 m) for a 30-day exercise. Within the first 6 days of training, 7 servicemen presented with severe, acute anxiety/panic with typical accompanying signs of sympathetic activation and no classic symptoms of acute mountain sickness (including headache). Four had a history of well-controlled psychiatric diagnoses. Invariably, cardiopulmonary and neurological evaluations were unrevealing, and acute cardiopulmonary events were excluded within limits of expeditionary diagnostic capabilities. All patients responded clinically to oxygen, rest, and benzodiazepines, returning to baseline function the same day. The unexpected onset of 7 cases of acute anxiety symptomatology coincident with recent arrival at moderate-to-high altitudes represents a highly unusual incidence and temporal distribution, suggestive of hypobaric hypoxemia as the proximal cause. We propose acute hypoxic physiological anxiety (AHPA) as a unique member of the spectrum of altitude-associated neurological disorders. Recognition of AHPA is particularly relevant in a military population; warfighters with anxiety spectrum diagnoses may have a recognizable and possibly preventable vulnerability.

INTRODUCTION

Military personnel are routinely exposed to a variety of mental, emotional, and physical stressors in the course of combat and/or high-intensity training operations that may render the warfighter at increased risk for mental health issues. Proper identification, treatment, and management of mental health issues are thus of great importance for the maintenance of readiness. Of particular importance is the constellation of anxiety disorders, including post-traumatic stress disorder (PTSD), also known as combat stress reaction, which consistently ranks among the most prevalent mental health disorders both in civilian and military populations (Table I).^{1–5}

Anxiety spectrum psychopathology can broadly be described as an anxious apprehension or abject fear of specific and/or nonspecific external stimuli. In military personnel, these sudden overwhelming symptoms can compromise

effective decision-making and interfere with combat readiness. It is important to note, however, that in a classic anxiety spectrum disorder such as a panic attack, the core psychoemotional response of a sudden, unexpected rise in terror is almost invariably associated with a host of autonomic (particularly cardiorespiratory) symptoms. This autonomic response (the characteristic sympathetic “fight or flight” response) has, until very recently, been considered an epiphenomenon of the underlying psychoemotional response to the trigger. However, a small but noteworthy evidence base suggests the reciprocal potential for physiological–environmental stressors (entirely separate from external psychological stressors) to precipitate anxiety spectrum symptomatology. For example, respiration and related autonomic mechanisms play an important role in the generation of abnormal states of anxiety seen in panic disorder; likewise, maneuvers such as carbon dioxide (CO₂) inhalation or breath holding have been reliably demonstrated to induce symptoms of anxiety.^{6,7} Additionally, in patients with a diagnosis of panic disorder, a hypoxic challenge may result in a significant increase in symptoms of anxiety and panic relative to healthy subjects.⁸ Klein et al⁹ postulated that some forms of panic disorder associated with a prominent respiratory response may be attributable to an overactive “suffocation alarm,” a confusion of stimuli.

The following case series is a description of the clinical presentation and treatment of 7 cases of acute anxiety spectrum symptomatology observed among 1,036 U.S. Marine Corps personnel who had recently arrived at moderate and high altitudes at the Marine Corps Mountain Warfare Training Center (MWTC) in Bridgeport, California (elevation 2,061–3,383 m/6,762–11,099 ft). They were engaged in a month-long battalion-level infantry exercise at MWTC, a setting

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TABLE I. DSM-IV Anxiety Disorders (1994)

Agoraphobia Without Panic Disorder
Social Phobia
Simple Phobia
Panic Disorder With Agoraphobia
Panic Disorder Without Agoraphobia
Generalized Anxiety Disorder
Obsessive-Compulsive Disorder
Post-traumatic/Combat stress Disorder

DSM-IV, Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition.

combining altitude-associated hypobaric hypoxia with operational stressors inherent in a range of training evolutions focused on offensive and defensive counterinsurgency operations in the face of difficult movements while traversing challenging mountainous terrain. The near simultaneous and unexpected onset of 7 cases of acute anxiety symptomatology coincident with recent arrival at moderate to high altitudes represents a highly unusual incidence, prevalence, and temporal distribution suggestive of hypobaric hypoxemia as the proximal cause.

CASE SERIES AND DATA

This case series consists of 6 individual Marines and 1 Navy corpsman, each presenting with acute anxiety spectrum symptomatology and having multiple commonalities with some interindividual differences. All patients were treated at the unit battalion aid station (BAS), located at the base of the training range (2,061 m/6,762 ft). Much of MWTC is located at 7,000 to 10,000 ft, with higher elevations over 11,000 ft. Most notably, the patients (none of whom trained closely together) presented to the BAS within the first 6 of approximately 30 days of training. The Marine battalion and specific patient demographics were not observed to be unusual (physically fit and well-conditioned 18- to 35-year-old men in good health, with a potentially increased incidence of traumatic brain injury [TBI] germane to an infantry unit).¹⁰ The majority of patients presented with some combination of chest pain, anxiety or panic attack, tachycardia, tachypnea, and diaphoresis; a minority presented with syncope or extremity numbness and tingling. Classic symptoms of acute mountain sickness (AMS; including headache) as defined by the 1991 Lake Louise AMS Consensus Criteria were absent in all 7; hence, no diagnosis of altitude illness (high-altitude headache or AMS) was made or even entertained.^{11,12} Four of 7 had a history of well-controlled psychiatric diagnoses in the anxiety disorders spectrum (panic disorder, depression, post-traumatic/combat stress-related illness), and the other 3 had no known history of psychiatric illness. Other Marines from the unit known to have mental health concerns that were not well controlled were not permitted to participate in the exercise and did not travel to the training facility with the battalion.

The broad range of normal resting oximetry at the MWTC BAS site for training units has generally been 92% and above

(D. Thomas, personal communication, August 2010). In the following cases, a minority of patients were found to have mildly depressed oximetry at the given altitude. Acute cardiopulmonary events were excluded to the extent possible given the limited diagnostic capabilities of the BAS, and all patients responded clinically to oxygen, rest, and benzodiazepine management. All patients returned to baseline psychiatric function within the same day. Because of the lack of significantly depressed oximetry, headache, or other characteristic symptoms, altitude illness was ruled unlikely by the treating physician.

With regard to the BAS capabilities and environment, patients were funneled out of moderate- and high-altitude training areas to the battalion's forward operating base and its associated BAS. The BAS was staffed in standard fashion, with 1 battalion surgeon working with multiple corpsmen to provide comprehensive medical care. Available medical capabilities were limited to those organic to a Marine Corps infantry battalion, with life-threatening disorders requiring urgent evacuation to a level 2 trauma center via civilian transport (longer than 1 hour away by air evacuation). Medical decision-making and documentation was similar to that of a BAS in a combat zone given the remote, austere, and expeditious nature of the training facility. Therefore, some data typically expected in a more carefully controlled inpatient or clinic setting were not available (i.e., the precise site and altitude of symptom onset).

Case 1

A 19-year-old male Marine in acute distress was sent to the BAS by company corpsmen from a training evolution at a higher altitude (the exact altitude and site unknown). He complained of acute chest pain and diaphoresis, but expressed no traditional altitude-associated cerebral symptomatology (no headache). The patient reported a family history of his father dying at age 50 from a myocardial infarction and reported similar symptoms during his initial training at the Marine Corps School of Infantry that resulted in a negative cardiology workup (including a stress test and echocardiogram) in the prior year. On initial examination, resting blood oxygen saturation (SaO₂) via pulse oximetry revealed a resting heart rate of 110 beats per minute and SaO₂ of 91%. Upon placing oxygen by nasal cannula (2 L), his heart rate decreased to the low 80s with SaO₂ reaching 98%. On physical examination, the patient's pupils were significantly dilated bilaterally; his cardiopulmonary and neurological evaluations were unremarkable. He was subsequently given 325 mg of aspirin and placed on oxygen (2 L/min via nasal cannula). After an appropriate interval of observation at rest with continued symptoms, acute cardiac pathology was deemed reasonably unlikely on clinical grounds, and the patient was given 2.5 mg of intravenous (IV) diazepam (Valium). His symptoms resolved immediately, and after a brief period of symptom-free observation, the patient was released. At 24-hour follow-up, there were no residual symptoms.

Case 2

A 28-year-old serviceman presented to the BAS from a higher altitude in acute distress; he complained of tachycardia, diaphoresis, and chest pain but denied traditional altitude-associated cerebral symptomatology. His history was notable for alcohol abuse, panic disorder, and PTSD from prior deployments. He had been managed with antidepressant medications and behavioral therapy; he was well controlled on a daily maintenance dose of 20 mg of citalopram (Celexa) at the time. The patient's respiratory and heart rates were moderately elevated, and SaO₂ was greater than 92%. He was also given oxygen at 2 L/min and rested. After an appropriate interval of observation, an acute cardiac event and/or alcohol withdrawal were deemed less likely; the patient denied alcohol use several days before or upon arrival at MWTC. He also denied other typical withdrawal symptoms, and medical staff deemed him reasonably outside of a concerning time frame for alcohol dependence-related illness. He was subsequently treated with 2 mg oral lorazepam (Ativan) to which he responded rapidly. The patient required oral lorazepam to control mild symptoms over the next several days, but otherwise was able to return to full activity without a return visit to the BAS.

Case 3

An otherwise healthy serviceman in his mid-20s presented at high altitude to his company corpsman with acute onset of symptoms typical of his previous attacks (severe anxiety, respiratory distress, and tachycardia). The patient had a known history of panic attacks (described as well controlled with a daily maintenance dose of venlafaxine [Effexor]) and a recent negative cardiac workup. He was brought to the BAS and received a one-time dose of 5 mg diazepam (Valium) IV to which he responded well clinically. At follow-up, he continued to require reassurance during several future episodes and required periodic oral lorazepam, but symptom severity never reached a level similar to his initial presentation.

Case 4

A male Marine in his late teens was brought to the BAS from a higher altitude because of complaints of acute chest pain accompanied by a nonspecific sense of apprehension or uneasiness, but he had no traditional altitude-associated cerebral symptomatology. There was no history of cardiopulmonary issues, and his family history was unremarkable. Pulse oximetry and a comprehensive clinical examination were unremarkable. He responded well to oxygen (2 L/min via nasal cannula) and rest, and symptoms fully resolved without pharmacological intervention. He reported no symptoms upon follow-up at 24 hours, and after several days was able to return to training with no further issues.

Case 5

A 19-year-old male Marine descended to the BAS from higher altitude in acute distress complaining of tachypnea,

tachycardia, and paresthesias (perioral and bilateral distal upper extremities), but no traditional altitude-associated cerebral symptomatology. The patient's personal and family histories were unremarkable. On initial examination, tachycardia and tachypnea were observed, and SaO₂ was above 92%. His clinical examination was also unremarkable, with no cardiac, pulmonary, or neurological abnormalities. After an appropriate period of observation with oxygen (2 L/min via nasal cannula) and rest, cardiac issues were deemed unlikely and he was given 5 mg of diazepam IV. The patient's symptoms resolved immediately, and he subsequently returned to duty with no further follow-up.

Case 6

A man in his early 20s with a known diagnosis of depression (disorder previously well controlled on a maintenance dose of an antidepressant) was sent to the BAS from training at a higher altitude on day 2 with a complaint of acute worsening of his previously documented symptoms of depression and anxiety. The patient also reported tachypnea and tachycardia, which were observed on initial presentation to the BAS, but there was no traditional altitude-associated cerebral symptomatology. Upon reporting suicidal ideation and an inability to contract for safety, and given the nature of training (hazards coincident with a mountain wilderness setting as well as the availability of live ammunition during portions of the exercise), the patient was evacuated to a higher level of psychiatric care and was briefly admitted at the Naval Medical Center San Diego.

Case 7

A 25-year-old experienced male Navy corpsman (combat medic) with history notable for well-controlled combat-related PTSD reported "nearly passing out" in the back of a transport vehicle following a moderate 3-hour foot movement with a pack weight described as "light." He had spent the entirety of his time before the patrol at the base camp altitude, but the patrol itself approached altitudes of over 9,100 ft. The patient was in his usual state of excellent health (not requiring use of any medication) until entering the transport vehicle to return to base camp, and he denied dehydration or associated symptoms (having hydrated appropriately, in his opinion). When the vehicle began to move, he suddenly began to experience what he described as "panic," experiencing an acute onset of shortness of breath, palpitations, and lightheadedness that spontaneously resolved over a period of approximately 10 minutes. He reported being well hydrated and denied headache, vertigo/lightheadedness, exhaustion/fatigue, or other traditional altitude-associated cerebral symptomatology. The patient's vitals and physical examination were wholly unremarkable. After a period of observation with no recurrence of symptoms, he was released and experienced no further episodes during training.

DISCUSSION

This series documents 7 cases of anxiety spectrum symptomatology among sea level-dwelling Marines newly arrived at moderate and high altitudes for military training. In each case, acute onset of anxiety and/or associated sympathetic hyperactivity was reported to occur spontaneously at high altitudes, with acuity substantial enough to warrant descent to the BAS for evaluation. In each case, the patient either denied a history of psychiatric illness of any kind, or had a history of anxiety disorder, depression, or PTSD that was well controlled with or without maintenance doses of appropriate psychiatric medications. Furthermore, when other aspects of the differential diagnosis were quickly ruled out, all responded well to descent, oxygen, and benzodiazepine treatment. Although much of the evidence is circumstantial, the constellation of similar symptoms and presentations, with tight temporal correlation to recent ascent warrant careful scrutiny of the literature to establish the potential for a common underlying pathophysiology potentially relatable to high-altitude hypoxemia.

Published case reports of well-documented episodes of acute onset anxiety at altitude are rare. This may be an underestimation because of issues such as self-selection bias, a lack of medical sophistication, a lack of access to medical providers with adequate psychiatric training, or a combination thereof. However, anxiety symptoms have been observed repeatedly in successive trekking and climbing seasons in the Himalayas on the high-altitude approach to Mount Everest, as well as repeatedly in controlled settings such as hypobaric chambers. We believe a substantive argument can be made that altitude-associated anxiety and associated sympathetic response is far more common than that described in the current literature. Before arrival at the MWTC, all Marines in the battalion were briefly instructed by the medical officer on signs and symptoms at altitude warranting immediate descent and medical attention to combat the threat of potentially serious illness worsening as a result of strong warrior ethos. Although this may have resulted in increased vigilance especially early on during training, it is less likely that this vigilance led to more cases occurring, but rather to more cases being reported.

Fagenholz et al¹³ described 6 cases of new-onset anxiety symptoms observed among western trekkers at the Himalayan Rescue Association clinic (4,240 m) on the Mount Everest trekking approach. Their observations drew significant parallels to our observations. However, in spite of this largest case series described, it appears the majority of peer-reviewed literature is otherwise based on subjective, low-powered, retrospective observations occurring during recreational wilderness expeditions. In one of the few controlled studies reporting anxiety with hypoxia, an aggressively controlled decompression to 25,000 ft in a hypobaric chamber, Papadelis et al¹⁴ commented on the finding that 4 of 10 subjects experienced symptoms of nervousness and/or panic. A recent important field study serendipitously documented the

potential significance of acute hypoxic physiological anxiety (AHPA) in a recent survey. Bian et al sought to identify comorbidities and/or risk factors for high-altitude headache among a large cohort of 850 Chinese workers flown into the Tibetan Plateau at approximately 3,700 m. They evaluated subjects with a self-report anxiety scale among other items and noted that a high score on the self-report anxiety scale was highly correlated with high-altitude headache (despite the low incidence of diagnosed anxiety disorders).¹⁵

Other explanations may exist for these anxiety symptoms in austere wilderness settings. Cashel et al¹⁶ reported statistically significant changes in mood status over the course of a wilderness experience without significant hypoxic exposure, and although anxiety was not measured directly, their results suggested varying levels of mood that could be trended. Therefore, it is understandable that the Marines in our cohort faced extreme demands physically, emotionally, and socially during a vigorous training event in an austere environment that may plausibly have influenced not only mood, but also the expression of anxiety spectrum symptomatology. However, this argument is weakened in light of the significant percentage of active duty personnel with anxiety disorders or diagnoses that would suggest vulnerability to anxiety (i.e., TBI and depression). Thus, patients with similar symptom complexes would have been expected to present to the BAS in accelerating frequency throughout their nearly month-long sojourn at moderate and high altitudes. In fact, the most notable statistic may be the most revealing: all 7 cases were seen in the first 6 days after arrival from sea level, and none were seen during the ensuing month. Whether this temporal distribution of cases was attributable to acclimatization or other psychosocial factors related to the training environment remains to be determined conclusively in careful study.

Explanatory models exist that describe the development of anxiety symptoms because of a pathophysiological response to hypoxia at high altitude. First to consider is the concept that hypoxia may initially lead to hypercapnia, leading to hyperventilation, which may then trigger a cascade of panic and/or anxiety symptoms.^{17,18} Second, the "suffocation false alarms" hypothesis posits that a hypersensitive brainstem autonomic control mechanism fires either spontaneously or after minor suffocation-related stimulation, thereby initiating both panic and a sensation of dyspnea. This dyspnea-panic phenomenon may be caused by either an elevation in CO₂ or proportionately greater decrements in oxygen, which in turn can result in a vicious cycle whereby feelings of suffocation and increased ventilation produce symptoms of anxiety.¹⁹ Third, the cognitive misinterpretation theory holds that symptoms from hypoxia and hypercapnia are interpreted as dangerous and produce the panic attack directly.²⁰ Finally, there may be a depressive component to the patient's mood state (with anxiety as a comorbidity) associated with the austere trekking environment prevalent at high altitudes.^{16,21-23} Interestingly, a 2005 editorial by Furman et al²⁴ describes a newly defined condition—migraine-anxiety-related dizziness—wherein patients

present with a combination of anxiety, migraine, and balance disorder in varying (and sometimes changing) degrees of severity. This approach to a spectrum of combined disease processes otherwise thought to occur independently may, in fact, have parallel implications in areas of altitude-related hypoxia, anxiety, and AMS. Unfortunately, none of these alternatives can be confidently commented on with regard to this case series as a result of a paucity of data in the relatively uncontrolled, dynamic environment of the expeditionary BAS.

It is particularly important to recognize the intersection of clinically relevant disorders. The most important and obvious comorbidity is a prior diagnosis of one of the anxiety spectrum disorders, of which the majority (4 out of 7) patients in the case series had. Recent literature has also suggested that hypoxia may uncover latent deficits because of mild TBI; another condition associated with symptoms of anxiety.²⁵ Although many of the aforementioned confounding factors are recognized, this pattern lends support to aspects of all models predicting that those with prior histories of anxiety spectrum psychiatric illness would more easily develop symptoms at altitude. To this point, Virués-Ortega et al^{21,22} remarked "...we observe a remarkable impact of personality traits associated with anxiety...as individual differences moderating the effects of exposure to altitude." Furthermore, confounding factors aside, it is important to emphasize and study environmental factors that may unmask a vulnerability specific to active duty military populations in an operational environment. Regardless, it is also important to note that we conceptualize these anxiety symptoms as an acute, circumstantially limited physiologic phenomenon, rather than as a psychiatric disorder. However, it is unclear if those with subclinical baseline anxiety may have greater vulnerability to altitude-associated anxiety.

Questions also arise regarding whether training with a high level of exertion in a hypoxic environment triggers a hyperventilatory response that in some patients is more likely to manifest as anxiety and/or panic, especially since in these cases all patients saw at least some improvement with oxygen therapy and rest during their initial presentations. The degree to which rest, reassurance, and benzodiazepine therapy alone represent a placebo response versus actual treatment of underlying hypoxemia with oxygen or other altitude-specific pharmacological interventions (i.e., acetazolamide, which was unavailable) remains to be determined. Of note, had these patients been seen in a facility with higher levels of care and diagnostics, electrocardiogram monitoring with cardiac enzymes would have been available and pharmacological treatment of anxiety may have been delayed. In these cases, after acute cardiac pathology could only be ruled out clinically, use of a low-dose benzodiazepine was temporally associated with a substantial treatment effect in most cases.

As previously discussed, medical decision-making in a forward BAS is limited to very basic acute care provided by a battalion surgeon and a host of corpsmen; their tools include oxygen, a limited range of medications and diagnos-

tics, and minor surgical capability, with no immediate access to higher care. Thus, the documentation of the aforementioned cases must be considered in context. The duration and specific altitude of training evolutions for each patient unfortunately were only roughly documented by medical personnel, and because the patients were generally in extremis upon presentation to the BAS, patients provided no history or a very limited and potentially unreliable history—such is the nature of expeditionary medical care in an operational environment.

Follow-up studies on this phenomenon of AHPA are indicated, particularly regarding a worsening of preexisting psychological and/or organic brain disorders known to be associated with anxiety (both of which have a higher incidence in military populations). It is reasonably likely that these cases represent an under-reported number of events given Marine Corps cultural mores calling for toughness and endurance in the call of duty, particularly in the atmosphere of an active infantry training exercise. Similar to the aforementioned documented clinical observations, several Marines and sailors reported similar symptoms in passing, including medical personnel who failed to recognize their symptoms as anything remarkable until later discussion. Future studies in high-altitude settings should systematically evaluate the relationship between anxiety sensitivity and development of anxiety symptoms, in addition to evaluation of cognitive processing and decision-making in vulnerable individuals. Such data may significantly influence force readiness in combatant commands, particularly in austere mountain combat environments where corpsmen and medics are primary medical responders (such as in eastern Afghanistan and the surrounding Hindu Kush region). Without readily available advanced care, many of these patients are likely to be commonly treated as heat/exertional stress or combat stress casualties with rest and IV fluids rather than anxiolytics and/or immediate descent. Improved knowledge would help differentiate these cases in such settings.

CONCLUSIONS/RECOMMENDATIONS

To our knowledge, we have documented the largest in vivo clinical case series describing the phenomenon of acute anxiety spectrum symptomatology on nascent exposure to altitude-associated hypoxemia, and it is the first reported case series of acute altitude-associated anxiety among Marines. The reasonable evidence described herein, coupled with accumulated supporting research, suggests a correlation between recent arrival at high altitude and acute anxiety-associated symptomatology. This possibility should be recognized in the clinical guidance for the spectrum of anxiety disorders and other comorbidities such as depression and TBI in wilderness and expeditionary medicine. The term AHPA is proposed to describe what is likely to be a unique member of the constellation of altitude-associated neurological disorders. Recognition of AHPA would be particularly relevant in a military population because of the substantial prevalence of anxiety disorders; a warfighter with these diagnoses may

have a recognizable vulnerability that can be averted with proper prevention and managed with appropriate recognition.

It is incumbent upon military medical providers to appreciate the psychological risks associated with austere environments. Just as military doctrine appropriately recognizes the importance of hygiene, immunizations, and prophylaxis for prevention of disease-related failures in operational efficiency, awareness of conditions such as AHPA is important because high-altitude regions have regularly been associated with recent combat environments, and mental health concerns continue to gain visibility. Furthermore, this work underscores the importance of leadership training for handling variations in mood state as well as a strengthened understanding of group dynamics in an austere setting, knowledge that may be invaluable among military leadership with regard to operations and medical intelligence for in-theater strategic planning.

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REFERENCES

1. Kessler RC, Ruscio AM, Shear K, Wittchen HU: Epidemiology of anxiety disorders. In: *Behavioral Neurobiology and Its Treatment. Current Topics in Behavioral Neurosciences*, Vol. 2, pp 21–35. Edited by Stein MB, Steckler T. Berlin, Heidelberg, Springer-Verlag, 2010.
2. Hoge CW, Auchterlonie JL, Milliken CS: Mental health problems, use of mental health services, and attrition from military service after returning from deployment to Iraq or Afghanistan. *JAMA* 2006; 295(9): 1023–32.
3. Hoge CW, Castro CA, Messer SC, McGurk D, Cotting DI, Koffman RL: Combat duty in Iraq and Afghanistan, mental health problems, and barriers to care. *N Engl J Med* 2004; 351(1): 13–22.
4. Wojcik BE, Akhtar FZ, Hassell LH: Hospital admissions related to mental disorders in U.S. Army soldiers in Iraq and Afghanistan. *Mil Med* 2009; 174(10): 1010–8.
5. American Psychiatric Association: *Diagnostic and Statistical Manual of Mental Disorders*, Ed 4 (DSM-IV), pp 393–444. Washington, DC, American Psychiatric Press, 1994.
6. Nardi AE, Freire RC, Zin WA: Panic disorder and control of breathing. *Respir Physiol Neurobiol* 2009; 167(1): 133–43.
7. Sardinha A, Freire RC, Zin WA, Nardi AE: Respiratory manifestations of panic disorder: causes, consequences and therapeutic implications. *J Bras Pneumol* 2009; 35(7): 698–708.
8. Beck JG, Ohtake PJ, Shipherd JC: Exaggerated anxiety is not unique to CO₂ in panic disorder: a comparison of hypercapnic and hypoxic challenges. *J Abnorm Psychol* 1999; 108: 473–82.
9. Klein DF: False suffocation alarms, spontaneous panics, and related conditions: an integrative hypothesis. *Arch Gen Psychiatry* 1993; 50: 306–17.
10. Ommaya AK, Dannenberg AL, Salazar AM: Causation, incidence, and costs of traumatic brain injury in the U.S. military medical system. *J Trauma* 1996; 40: 211–7.
11. Roach RC, Bärtsch P, Oelz O, Hackett PH, Lake Louise AMS Scoring Consensus Committee: The Lake Louise acute mountain sickness scoring system. In: *Hypoxia and Molecular Medicine*, pp 272–4. Edited by Sutton JR, Houston CS, Burlington Coates G., VT, Charles S. Houston, 1993.
12. Hackett PH, Roach RC: High-altitude illness. *N Engl J Med* 2001; 345: 107–14.
13. Fagenholz PJ, Murray AF, Gutman JA, Findley JK, Harris NS: New-onset anxiety disorders at high altitude. *Wilderness Environ Med* 2007; 18(4): 312–6.
14. Papadelis C, Papadeli CK, Bamidis PD, Maglaveras N, Pappas K: The effect of hypobaric hypoxia on multichannel EEG signal complexity. *Clin Neurophysiol* 2007; 118: 31–52.
15. Bian S, Zhang J, Gao X, et al: Risk factors for high-altitude headache upon acute high-altitude exposure at 3700 m in young Chinese men: a cohort study. *J Headache Pain* 2013; 14: 35.
16. Cashel CM, Lane S, Montgomery D: Emotional response patterns of participants during a wilderness experience. *Wilderness Environ Med* 1996; 7(1): 9–18.
17. Roth WT, Gomolla A, Meuret AE, Alpers GW, Handke EM, Wilhelm FH: High altitudes, anxiety, and panic attacks: is there a relationship? *Depress Anxiety* 2002; 16(2): 51–8.
18. Smoller JW, Pollack MH, Otto MW, Rosenbaum JF, Kradin RL: Panic anxiety, dyspnea, and respiratory disease: theoretical and clinical considerations. *Am J Respir Crit Care Med* 1996; 154: 6–17.
19. Klein DF: False suffocation alarms, spontaneous panics, and related conditions. An integrative hypothesis. *Arch Gen Psychiatry* 1993; 50(4): 306–17.
20. Clark DM: A cognitive approach to panic. *Behav Res Ther* 1986; 24: 461–70.
21. Virués-Ortega J, Buéla-Casal G, Garrido E, Alcázar B: Neuropsychological functioning associated with high-altitude exposure. *Neuropsychol Rev* 2004; 14(4): 197–224.
22. Virués-Ortega J, Garrido E, Javierre C, Kloezeman KC: Human behaviour and development under high-altitude conditions. *Dev Sci* 2006; 9(4): 400–10.
23. Basnyat B, Cumbo TA, Edelman R: Acute medical problems in the Himalayas outside the setting of altitude sickness. *High Alt Med Biol* 2000; 1(3): 167–74.
24. Furman JM, Balaban CD, Jacob RG, Marcus DA: Migraine–anxiety related dizziness (MARD): a new disorder? *J Neurol Neurosurg Psychiatry* 2005; 76: 1–8.
25. Temme L, Bleiberg J, Reeves D: Uncovering latent deficits due to mild traumatic brain injury by using normobaric hypoxic stress. *Front Neurol* 2013; 4(41): 1–7.

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14. ABSTRACT Management of mental health is critical for maintenance of readiness in austere military environments. Emerging evidence implicates hypoxia as an environmental trigger of anxiety spectrum symptomatology. Unacclimatized infantry Marines (1,036) ascended from sea level to the Marine Corps Mountain Warfare Training Center (2061–3383 m) for a 30-day exercise. Within the first 6 days of training, 7 servicemen presented with severe, acute anxiety/panic with typical accompanying signs of sympathetic activation and no classic symptoms of acute mountain sickness (including headache). Four had a history of well-controlled psychiatric diagnoses. Invariably, cardiopulmonary and neurological evaluations were unrevealing, and acute cardiopulmonary events were excluded within limits of expeditionary diagnostic capabilities. All patients responded clinically to oxygen, rest, and benzodiazepines, returning to baseline function the same day. The unexpected onset of 7 cases of acute anxiety symptomatology coincident with recent arrival at moderate to high altitudes represents a highly unusual incidence and temporal distribution, suggestive of hypobaric hypoxemia as the proximal cause. We propose acute hypoxic physiological anxiety (AHPA) as a unique member of the spectrum of altitude-associated neurological disorders. Recognition of AHPA is particularly relevant in a military population; warfighters with anxiety spectrum diagnoses may have a recognizable and possibly preventable vulnerability.					
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